# REPORT DOCUMENTATION PAGE

*Form Approved*
*OMB No. 0704-0188*



| 1. REPORT DATE *(DD-MM-YYYY)* | 2. REPORT TYPE | 3. DATES COVERED *(From - To)* |
|---|---|---|
| 30 January 2006 | Final report | 03/01/2003-08/31/2005 |

**4. TITLE AND SUBTITLE**
Advanced Tethered Vehicle (ATV) Activation Project

**5a. CONTRACT NUMBER**

**5b. GRANT NUMBER**
N-00014-03-1-0565

**5c. PROGRAM ELEMENT NUMBER**

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**5e. TASK NUMBER**

**5f. WORK UNIT NUMBER**

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**8. PERFORMING ORGANIZATION REPORT NUMBER**

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**
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800 N. Quincy
Arlington, VA 22217-5660

**10. SPONSOR/MONITOR'S ACRONYM(S)**
ONR

**11. SPONSOR/MONITOR'S REPORT NUMBER(S)**

**12. DISTRIBUTION/AVAILABILITY STATEMENT**
**DISTRIBUTION STATEMENT A**
Approved for Public Release
Distribution Unlimited

**13. SUPPLEMENTARY NOTES**

**14. ABSTRACT**

The ATV was retired by the Navy and then transferred the system to SIO for science use. At the time of transfer the system was not fully operational and remained idle until ONR provided funding for an evaluation operation in 2003. Repairs to propulsion, hydraulics, and electronics were undertaken. This was carried out successfully in May, 2003, in 1100 m water, supported by R/V Roger Revelle. The dives demonstrated geological sample collection and a successful recovery of a lost ocean floor instrument. While this operation demonstrated that ATV provides a viable platform for heavy seafloor work it also illuminated the need for improvement in several areas. Some of the more significant deficiencies include inoperable manipulators and hydraulic thrusters. Our group has written several proposals to establish the ATV as an operational science asset, but none of them have been funded. A vehicle hanger has been built to store the ATV until further funding can be obtained.

**15. SUBJECT TERMS**
Advanced Tethered Vehicle (ATV)
Remotely Operated Vehicle (ROV)

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
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| U | U | U | UU | 5 | 19b. TELEPHONE NUMBER *(Include area code)* (858) 534-3533 |

# Final Report

# Advanced Tethered Vehicle (ATV) Activation Project

The Advanced Tethered Vehicle (ATV) was built by the Hawaii branch of the Navy Ocean Systems Center (NOSC - now Space and Naval Warfare Systems Center) in the early 1990's and delivered to Submarine Development Group 1 (now Submarine Development Squadron 5) in San Diego in 1993. The Development Group operated the vehicle system with contract assistance from Oceaneering International, Inc. over the subsequent years. Examples of scientific missions conducted with ATV in that era are reported by Dziak et al. (1996) and Rona et al. (1997). A major upgrade was carried out in 1996-97, primarily to enhance deck handling, telemetry and power capabilities. Two new cables, each with 3 optical fibers and 3 copper electrical conductors, and a Dynacon traction winch/storage drum system were purchased and integrated into the system, providing improved telemetry and power. This version of the system was used in 1998 to locate and photograph the wreck of USS Yorktown at a depth of 5075 m in the north Pacific. Subsequently the Navy decided to reduce its deep submergence assets and transferred the system to SIO for science use.

At the time of transfer the system was not fully operational and it remained idle until ONR provided funding for an evaluation operation in 2003. This was carried out successfully in May, 2003, in 1100 m water, supported by R/V Roger Revelle and with assistance from Oceaneering personnel.

The photograph on the next page shows the system as it was installed in R/V Revelle. The current vehicle mass is 6000 kg; in seawater the vehicle is positively buoyant by 90 kg. Its components are rated for a maximum operating depth of 6,100 m and include 5 video cameras, 2 CTFM sonars, an acoustic altimeter, a pressure gauge for depth, and two force feedback


manipulators. The A-frame is part of the original handling gear and is well designed for its job. The main winch and storage drum system for handling the umbilical was built by Dynacon and delivered to the Navy in 1997. It will hold 7,000 m of 1.2" diameter cable and incorporates the technology used in a number of comparable winches in use in the University-National Oceanographic Laboratory System (UNOLS) fleet. The original lift cable slack tensioner was replaced by a modern SIO Dynacon unit that has appropriate handling capability and substantially reduced footprint.

The umbilical and associated handling system comprise a modern and uniquely capable asset. The cable itself is unusual in the deep ROV world in terms of its power handling capability. Other ROVs make use of the UNOLS standard 0.680" electro-optical cable. While its availability on some UNOLS ships is an advantage there is one important drawback—the UNOLS 0.680" cable contains three copper conductors each consisting of an AWG 11 wire

having 4.9 Ω/km resistance capable of sustaining a 2800 V potential. The ATV cable has three AWG 6 conductors (1.4 Ω/km) rated at 3000 V (both the UNOLS and the ATV cables contain three single-mode optical fibers). For some applications requiring high power delivery, this combination of higher voltage and lower resistance will be an important capability. The control van is a 20 foot container housing the controls, displays, shipboard power distribution, telemetry interfaces and other electronics. The interior layout is adequate for good vehicle operation by a pilot and co-pilot with room for a supervising scientist and one or two others. In the Navy's operating mode there was video and communication to other locations in the ship and that option was implemented in our operations as well. During one portion of the evaluation trip images were streamed to shore using the ROADNet satellite Internet system installed in Revelle [see http://roadnet.ucsd.edu].

Based on our experience with the installation in R/V Revelle the system could be used with any of the larger UNOLS ships – Thompson, Melville, Knorr, Brown. While the requirements for deck space are significant, the installation in Revelle showed that the entire starboard side could remain clear for other research support functions – the situation would be comparable for the other ships in the list.

The ATV system constitutes a versatile ROV system capable of supporting a wide range of research or developing systems for seafloor work, particularly if heavy lift, substantial power and/or operations to 6100 meters are required.

**Current Status**

After the successful 2003 operation, the ATV was demobilized at the Nimitz Marine Facility in Point Loma. The manipulators and two hydraulic thrusters are non-operational. Several proposals were presented to NSF and ONR to complete further work on the ATV to improve its utility as a deep ocean work asset. The proposals were declined, and the remainder of the funds in this grant was used to construct a secure

hanger to house the vehicle and its support equipment. We are attempting to secure additional funding to complete repairs to the vehicle.

## References


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